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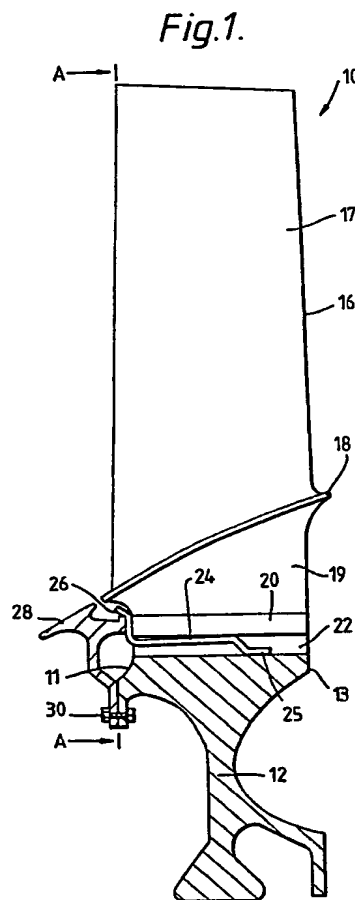
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GB 2038959 A GB 2021206 A GB 1491480 A
EP 0110744 A1 EP 0083289 A1 US 4478554 A
US 4265595 A US 4208170 A

(58) Field of search
 UK CL (Edition K) **F1V VCN**
 INT CL⁵ **F01D, F04D**

(54) **Fan blade retainer**

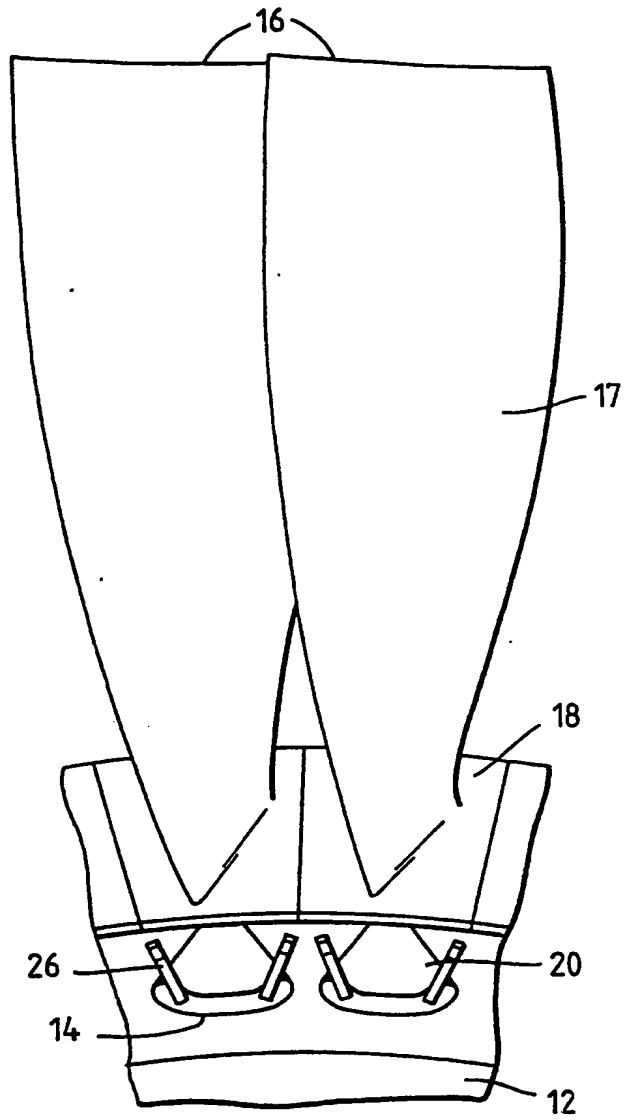
(57) A rotor 10 has radially extending fan blades 16 disposed circumferentially around a rotor disc 12. The blades 16 have roots 20 which are located in grooves 14 in the periphery of the rotor disc 12. An elongate member 24 is interposed between the bottom of the groove 14 and the blade root 20 and has one end 25 attached to the bottom of the groove.

The elongate member 24 has projections 26 which extend forward of an upstream face 11 of the rotor disc 12. A thrust ring 28 engages the projections 26 urging them radially outward. In an alternative arrangement (Figure 3) one end of the elongate member is attached to the blade root while projections at the other end are urged radially inward by a thrust ring. Movement of the projections 26 causes a radially outward load to be applied to the blade root 20 which inhibits radial movement of the blade root 20 in the groove 14.



At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

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Fig. 2.

BLADE RETAINER

The present invention relates to a device for retaining radially projecting blades on a rotor. In particular it relates to a device suitable for retaining fan blades on a rotor disc of a gas turbine engine such that radial movement of the blades relative to the rotor disc is prevented.

In a gas turbine engine a rotor, such as a fan rotor, has radially extending fan blades which are located in a plurality of grooves disposed circumferentially around a rotor disc. If the gas turbine engine is mounted on an aircraft and the engine is not operational wind passing through the fan rotates it. This is known as windmilling and as the fan rotates slowly the blades are able to move within the circumferential grooves as there is insufficient centrifugal force to push the fan blades radially outwards against the rotor disc. This movement can result in serious scoring and fretting of the blade root.

To avoid fretting of the blade roots it is known to insert biasing blocks between the bottom of the groove and the blade root. These biasing blocks are in the form of rubber wedges which exert a radially outward force on the blade root to hold the blade root firmly in contact with the rotor disc. Due to manufacturing tolerances the radial load exerted on the blade root by the rubber wedges can vary considerably. If the radial load is too great installation difficulties are experienced as the load must be overcome to install the wedge in the groove beneath the blade root. A further problem with the rubber wedges is that over a period of time the wedge which is under compression will deform plastically reducing the radial load and allowing some movement of the blade root in the groove which results in wear.

The present invention seeks to provide an improved retention device which biases the blades radially outward

in the grooves of the rotor disc and is easy to install and does not necessitate the use of an elastomer material. According to the present invention a retention device for applying a radially outward load on a blade mounted on a rotor disc, the blade having a root which is received in a one of a plurality of grooves disposed circumferentially around the rotor disc, the rotor disc having an upstream face and a downstream face, there being provided a space between a radially inward face of the groove and the blade root into which the retention device is inserted, the retention device comprising an elongate member one end of which is operationally attached to either the radially inward face of the groove or the blade root the other end having an at least one projection which extends forward of the upstream face of the elongate member is attached to the at least one end of the elongate member it radially outwardly when the one end of the groove or urging it radially inward when the one end of the elongate member applies a radially outward load on the blade root to inhibit radial movement of the blade root in the groove.

In one embodiment of the present invention a retention device for applying a radially outward load on a blade mounted on a rotor disc, the blade having a root which is received in a one of a plurality of grooves disposed circumferentially around the rotor disc, the rotor disc having an upstream face and a downstream face, there being provided a radial space between a radially inward face of the groove and the blade root into which the retention device is inserted, the retention device comprises an elongate member one end of which is operationally attached to the radially inward face of the groove the other end having an at least one projection which extends forward of the upstream face of the rotor disc and means for engaging the at least one projection urging it radially outward so that the elongate member is

brought into contact with the blade root to apply a radially outward load on the blade root and inhibit radial movement of the blade root in the groove. The at least one projection may be inclined radially outward.

In a further embodiment of the present invention a retention device for applying a radially outward load on a blade mounted on a rotor disc, the blade having a root which is received in a one of a plurality of grooves disposed circumferentially around the rotor disc, the rotor disc having an upstream face and a downstream face, there being provided a radial space between a radially inward face of the groove and the blade root into which the retention device is inserted, the retention device comprises an elongate member one end of which is operationally attached to the blade root the other end having an at least one projection which extends forward of the upstream face of the rotor disc and means for engaging the at least one projection urging it radially inward so that the elongate member is brought into contact with the bottom of the groove so that the one end of the elongate member attached to the blade root applies a radially outward load on the blade root to inhibit radial movement of the blade root in the groove. The at least one projection may be inclined radially inward.

Preferably the means for engaging the at least one projection is a thrust ring which is attached to the upstream face of the rotor disc.

Preferably a pair of projections are provided on the end of the elongate member which extend forward of the upstream face of the disc.

The elongate member may be manufactured from carbon composite or sheet metal.

The present invention will now be described with reference to the accompanying drawings in which:

Figure 1 is a partially cross-sectional view of a rotor having a radially projecting blade retained thereon in accordance with one embodiment of the present

invention.

Figure 2 is a pictorial view of part of the rotor, when viewed along line AA in figure 1, having the blades retained thereon in accordance with the embodiment of the present invention shown in figure 1.

Figure 3 is a partially cross-sectional view of a rotor having a radially projecting blade retained thereon in accordance with a further embodiment of the present invention.

Referring to figure 1 a rotor of a gas turbine engine, generally indicated at 10, rotates about an axis (not shown). The rotor 10 comprises a disc 12 having a plurality of radially extending blades 16 mounted thereon. The disc 12 has a plurality of grooves 14, figure 2, in the circumference thereof in which the fan blades 16 are mounted. A fan blade 16 has an aerofoil section 17, a platform 18, a shank 19 and a root 20. The blade root 20 has a shape corresponding to the groove 14 in the disc 12. The blade root 20 may be of dovetail or other form and engages the disc 12 by sliding axially into the groove 14.

The grooves 14 extend across the periphery of the disc 12 from an upstream face 11 to a downstream face 13. When the blade root 20 is in situ in the groove 14 there is a space 22 between the bottom of the blade root 20 and the bottom of the groove 14. In order to prevent radial movement of the blade root 20 within the groove 14 an elongate member 24 is inserted into the space 22 beneath the blade root 20.

In one embodiment of the present invention, shown in figure 1, one end 25 of the elongate member 24 is attached to the bottom of the groove 14 to maintain it in position. The free end of the elongate member 24 is provided with a pair of projections 26 which extend forward of the upstream face 11 of the disc 12. The projections 26 are tapered and are inclined radially outward. When elongate members 24 have been positioned beneath

each of the blades 14 in the rotor 10 a thrust ring 28 is offered up to the upstream face 11 of the disc 12. The thrust ring 28 engages the projections 26 urging them radially outward. Movement of the projections 26 radially outward biases the elongate member 24 towards the blade root 20. The elongate member 24 comes into contact with the bottom of the blade root 20 and exerts a radially outward force thereon. The radially outward force exerted on the blade root 20 prevents the blade root 20 from moving radially in the groove 14.

In a further embodiment of the present invention, shown in figure 3, the end 25 of the elongate member 24 is attached to the bottom of the blade root 20 to maintain it in position. The free end of the elongate member 24 is provided with a pair of projections 26 which extend forward of the upstream face 11 of the disc 12. The projections 26 are tapered and are inclined radially inward.

When elongate members 24 have been positioned beneath each of the blades 14 in the rotor 10 a thrust ring 28 is offered up to the upstream face 11 of the disc 12. The thrust ring 28 engages the projections 26 urging them radially inward. Movement of the projections 26 radially inward biases the elongate member 24 towards the bottom of the groove 14. The elongate member 24 comes into contact with the bottom of the groove 14 and the end 25 of the elongate member 24 exerts a radially outward force on the blade root 20. The radially outward force exerted on the blade root 20 prevents the blade root 20 from moving radially in the groove 14.

In both of the embodiments described the thrust ring 28 engages with the projections 26 of the elongate members 24 under each of the blades 16 so that a radially outward force is exerted on all the blades 16 in the rotor 10. The radially outward force is not exerted on the blades 16 until the thrust ring 28 is mounted on the upstream face 11 of the disc. The thrust ring 28 is attached to the

upstream face 11 of the disc 12 by bolts 30. The thrust ring 28, once attached to the upstream face 11 of the disc 12, maintains the elongate member 24 in the biased position and prevents axial movement of the blades 16.

The elongate member 24 may be manufactured from either pressed out metal or carbon composite material.

Claims:

1. A retention device for applying a radially outward load on a blade mounted on a rotor disc, the blade having a root which is received in a one of a plurality of grooves disposed circumferentially around the rotor disc, the rotor disc having an upstream face and a downstream face, there being provided a radial space between a radially inward face of the groove and the blade root into which the retention device is inserted, the retention device comprising an elongate member one end of which is operationally attached to either the radially inward face of the groove or the blade root the other end having an at least one projection which extends forward of the upstream face of the rotor disc and means for engaging the at least one projection urging it radially outward when the one end of the elongate member is attached to the radially inward face of the groove or radially inward when the one end of the elongate member is attached to the blade root so that the elongate member applies a radially outward load on the blade root to inhibit radial movement of the blade root in the groove.

2. A retention device for applying a radially outward load on a blade mounted on a rotor disc, the blade having a root which is received in a one of a plurality of grooves disposed circumferentially around the rotor disc, the rotor disc having an upstream face and a downstream face, there being provided a radial space between a radially inward face of the groove and the blade root into which the retention device is inserted, the retention device comprising an elongate member one end of which is operationally attached to the radially inward face of the groove the other end having an at least one projection which extends forward of the upstream face of the rotor disc and means for engaging the at least one projection urging it radially outward so that the elongate member is brought into contact with the blade root to apply a radially outward load on the blade root and inhibit radial movement of the blade root in the groove.

3. A retention device for applying a radially outward load on a blade mounted on a rotor disc, the blade having a root which is received in one of a plurality of grooves disposed circumferentially around the rotor disc, the rotor disc having an upstream face and a downstream face, there being provided a radial space between a radially inward face of the groove and the blade root into which the retention device is inserted, the retention device comprising an elongate member one end of which is operationally attached to the blade root the other end having at least one projection which extends forward of the upstream face of the rotor disc and means for engaging the at least one projection urging it radially inward so that the elongate member is brought into contact with the bottom of the groove so that the one end of the elongate member attached to the blade root applies a radially outward load on the blade root to inhibit radial movement of the blade root in the groove.

4. A retention device as claimed in claim 2 in which the at least one projection is inclined radially outward.

5. A retention device as claimed in claim 3 in which the at least one projection is inclined radially inward.

6. A retention device as claimed in any preceding claim in which the means for engaging the at least one projection is a thrust ring which is attached to the upstream face of the rotor disc.

7. A retention device as claimed in any preceding claim in which a pair of projections are provided on the end of elongate member which extends forward of the upstream face of the disc.

8. A retention device as claimed in any preceding claim in which the elongate member is manufactured from carbon composite.

9. A retention device as claimed in any of claims 1-7 in which the elongate member is manufactured from pressed metal.

10. A retention device as hereinbefore described with reference to and as shown in figures 1 and 2.
11. A retention device as hereinbefore described with reference to and as shown in figure 3.

Examiner's report to the Comptroller under
Section 17 (The Search Report)

Application number

9125820.2

Relevant Technical fields

- (i) UK Cl (Edition K) F1V (VCN)
- (ii) Int CL (Edition 5) F01D, F04D

Search Examiner

C B VOSPER

Databases (see over)

- (i) UK Patent Office
- (ii)

Date of Search

15 MAY 1992

Documents considered relevant following a search in respect of claims

1 TO 11

| Category (see over) | Identity of document and relevant passages | Relevant to claim(s) |
|------------------------|--|-------------------------|
| X | GB 2038959 A (GENERAL) see Figure 1 and 4 and page 3 lines 20 et seq | 1,3,5, and 7 |
| X | GB 2021206 A (GENERAL) see whole document but note figure 10 and page 4 lines 79 et seq, in particular | 1,2 and 4 |
| A | GB 1491480 (ROLLS) see Figure 3 | 1 and 2 at least |
| X | EP 0110744 A1 (SOCIETE) see Figure 1 and note action of wedge 23 on member 13 | 1 and 3 |
| A | EP 0083289 A1 (SOCIETE) see Figure 4 | 1 and 2 at least |
| X | US 4478554 (S.N.E.C.M.A) see Figure 1 and note action of wedge 23 on member 13 | 1 and 3 |
| X | US 4265595 (GENERAL) see Figures 1 and 4 and column 5 lines 32 et seq | 1,3,5 and 7 |
| X | US 4208170 (GENERAL) eg see Figure 4 to 6 and column 5 line 68 to column 6 line 8 | 1 & 2 |

| Category | Identity of document and relevant passages | Relevant to claim(s) |
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Categories of documents

X: Document indicating lack of novelty or of inventive step.

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